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ABSTRACT

Chomsky and Halle claim that an orthography based on their underlying phonological representations (UPR) of lexical items would be optimal for English. This paper challenges two of Chomsky and Halle's basic phonological assumptions: (1) that their Vowel Shift Rule is valid, and (2) that derived words do not appear as wholes in the lexicon. A less abstract phonological representation level based on the conscious perceptions of speakers, the surface phonemic representation (SPR), is proposed. An SPR-based orthography has advantages which a UPR-based orthography would not: it is easy to learn and teach; it can be learned at an early age; and it permits rapid detection of rhyme. It is concluded that an orthography based on SPRs, and not UPRs, would be optimal. (Author)

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ON CHOMSKY AND HALLE'S OPTIMAL ORTHOGRAPHY[1]

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ABSTRACT

Chomsky and Halle claim that an orthography based on their underlying phonological representations (UPR) of lexical items would be optimal for English. This paper challenges two of C&H's basic phonological assumptions, that their Vowel Shift Rule is valid, and that derived words do not appear as wholes in the lexicon. A less abstract phonological representation level based on the conscious perceptions of speakers, the surface phonemic (SPR), is proposed. A SPR based orthography has advantages which a UPR based orthography would not: it is easy to learn and teach, it can be learned at an early age, and it permits rapid detection of rhyme. It is concluded that an orthography based on SPRs, and not UPRs, would be optimal.

INTRODUCTION

The investigations of N. Chomsky & Halle (1968) into the sound system of English have led them to posit a certain system of underlying phonological representations (hereafter, UPR) for lexical items. This system is of prime importance in these theorists' consideration of the problem of an optimal orthography for English. They hold that the process of reading will be facilitated to the extent that an orthography corresponds to their UPRs for lexical items.[3]

The rationale behind the view that an orthography based on their UPR level is one that would be optimal for reading, is perhaps most clearly expressed by C. Chomsky (1970) in what is essentially an elaboration of the Chomsky and Halle (hereafter, C&H) position. She states,

> "Consider also the common items of words such as courage/courage-ous, or anxi-ous/anxi-ety, or photograph-photograph-y/photograph-ic. Although the phonetic variations are considerable, they are perfectly automatic, and the lexical spellings can ignore them. They will be introduced by the phonological component. Of course, the conventional orthography ignores them as well. These are good examples of cases where the conventional orthography, by corresponding to lexical spelling rather than phonetic representation, permits immediate direct identification of the lexical item in question, without requiring the reader to abstract away from the phonetic details, and presents the lexical item directly, as it were." [p. 291-2]

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Thus, because it is believed that a UPR based orthography would permit "immediate direct identification" of lexical items, it is held that an optimal orthography would be one that is based on the UPR.

To illustrate the C&H view, let us first consider a lexical item. Chomsky and Halle (1968:218) assign the following derivation for the lexical item, mountain, to the competence of the English speaker:

	/mūntən/	UNDERLYING PHONOLOGICAL REPRESENTATION
		↓
		PHONOLOGICAL
DIPHTHONGIZATION	mūwntən	RULES
		↓
VOWEL SHIFT	mɔ̄wntən	
		↓
RULE 93c	[māwntən]	PHONETIC REPRESENTATION

In the derivation, the phonetic representation of the lexical item [māwntən] is associated only indirectly to the underlying phonological representation /mūntən/. This association is made by means of various phonological rules. On the other hand, the UPR /mūntən/ is directly associated with the meaning of the lexical item since it is the UPR that is stored in the lexicon with meaning. The specification of the UPR will allow for the identification of an item and its meaning in the lexicon. Given this phonological system, one could then devise an orthography based on the UPRs of lexical items, e.g., <mūntən> could symbolize /mūntən/ (let angled brackets indicate an orthographic representation). One could also, of course, devise an orthography based on the phonetic representation of lexical items, e.g., <māwntən> for [māwntən].

According to Halle and the Chomskys, the UPR based orthography would be the superior orthography since it would provide input at a level closer to meaning. They say that orthographic input at the UPR level would not require the use of phonological rules in the recovery of meaning, whereas, orthographic input at the phonetic level would require the use of phonological rules in the recovery of meaning. With regard to performance and the use of rules, C. Chomsky (1970 states that, "In producing and interpreting speech, a speaker of the language constantly operates with rules such as these [phonological] .... In the course of acquiring his language he has internalized the rules of its phonological system, and as a mature speaker he operates in accordance with them both in speaking and in comprehending the spoken language." [p. 291] Thus it is that these theorists contend that a UPR based orthography would allow for a more rapid discovery of meaning than would a phonetically based one.

The UPR based orthography "permits immediate direct identification of the lexical item in question" while the phonetically based one requires "the reader to abstract away from the phonetic details" by the utilization of phonological rules.

While the account which C&H present regarding the optimality of an orthography for English based on their UPR analysis is interesting, there is reason to believe that it is not a valid one. C&H's phonological analysis unfortunately rests on a number of dubious assumptions: 1) the vowel shift rule is psychologically valid, 2) the C&H UPR is the only sound representation that is to be listed in the lexicon, and 3) derived forms cannot appear as whole words in the lexicon. Each of these assumptions will now be discussed in turn.

DUBIOUS ASSUMPTIONS

DUBIOUS ASSUMPTION 1: THE VOWEL SHIFT RULE (VSR) IS VALID.

According to C&H, even the commonest of words have UPRs which differ significantly from their phonetic representation. For example, the vowels in words like time and team have UPRs which are not distinct from the phonetic representations in seem and same, respectively, where /ī/ underlies [ā^{y}], and /ē/ underlies [ī^{y}]. Primarily because vowel alternations appear in a number of cases of related words such as severe-severity, divine-divinity, grave-gravity, and because this relationship can be specified with a VSR and certain other rules, C&H hold that speakers have internalized a VSR and operate in accordance with it in the production and understanding of lexical items. Since the VSR is considered to be a general rule, i.e., it operates on the UPRs of all lexical items unless an item is marked as an exception, the UPRs of most lexical items are therefore frequently required to have vowels which differ considerably from those in the phonetic representation. Thus, it is that C&H regard their UPRs and the VSR as part of the competence of the native speaker of English.

Suppose, however, that the VSR were not a rule that the English speaker knows and generally applies. If this were the case, then most of the UPRs for lexical items posited by C&H would be incorrect. The findings of an experiment which I have just conducted with my colleague, Robert Krohn, bear directly on this issue. I would now like to present a brief summary of that experiment, the findings of which will be reported to the International Congress of Psychology in Tokyo this summer.

VSR Validity Experiment. In our investigation the validity of the VSR was assessed by testing the rule's hypothesized productivity with regard to novel derived forms.

The subjects (Ss) were 25 native English speakers randomly chosen from an undergraduate psychology course. Five different vowels which, in the final syllabic position of the base form, are postulated by C&H to alternate in their derived forms, were selected for study. These vowels and their alternations are [ā^{y}]-[i] as in divine-divinity, [ī^{y}]-[e] as in extreme-extremity, [ē^{y}]-[æ] as in sane-sanity, [ō^{w}]-[ā] as in verbose-verbosity, and [ā^{w}]-[ʌ] as in pronounce-pronunciation. For each of the five different base form vowels, four or five different ordinary words were selected as experimental items. A total of 21 experimental items was presented to each S.

In a meaningful sentence context, Ss were to select one of two suffixes, affix it to the base given, and then pronounce the derived form. The suffixes were arranged so that either selection is hypothesized by C&H to trigger vowel shifting. However, since only one of the suffixes resulted in the appropriate part of speech for the context, Ss would usually make the same choice. So as to divert them from focusing upon the pronunciation of the forms, Ss were told that the experiment was attempting to determine their preference for suffixes. Post-experiment interviews with Ss indicated that none were aware that pronunciation, and not suffix choice, was the concern of the experiment.

The following are some of the test items with the two suffix choices presented for each. The suffix not in parenthesis indicates the contextually appropriate choice.

BASE	SUFFIX	BASE	SUFFIX
maze	ic (ity)	drape	ify (ic)
snide	ity (ical)	tripe	ical (ify)
kerosene	ical (ify)	effete	ity (ical)
honeycomb	ical (ify)	overgrown	ity (ical)
house	ify (ic)	trout	ic l (ify)

As an example of meaningful context in which items were presented, the following is the one presented for the item trout:

> "A trout is a fish. [Pause]. We had raised this trout from the time it hatched. When we released it in the river we watched to see if it had the swimming abilities of a free trout. It swam in a true BLANK fashion."

The Ss were required to repeat the final sentence, filling the blank with trout plus either -ical or -ify. The C&H theory predicts pronunciations of [trʌtikəl] and [trʌtifā^{y}]. Preselection insured that the derived forms would be novel for the S. (Some of the derived forms are even actual,

but rare words, e.g., mazic.) The experiment was recorded on tape and presented aurally to each S individually. S's responses were recorded for later scoring.

Of the responses made by the 25 Ss to the items, it was found that there was no vowel change from the base to the derived form in over 90% of the cases. Of the 46 vowel changes that did occur, only 17 (about 3% of all responses) were in accord with the C&H prediction. Incidentally, no S said [trʌtikəl] on the trout item. They all said [trāʷtikəl].

These results clearly show that the C&H rule relating to vowel shifting is virtually unproductive. Consequently, the C&H claim that such a rule is psychologically valid is extremely doubtful. Even if one argues that the rule nevertheless is known by the speaker, it certainly cannot be considered to be "general", such as say the plural suffix rule of English which Berko (1958) demonstrated to be productive. At best, the VSR could only account for what would have to be called exceptions to the general pattern, that of non-alternation.

That the criterion of productivity is assigned so critical a role in the determination of the validity of rules, should not be surprising. Productivity is essential for distinguishing, as Maher (1971) neatly puts it, between generative phonology (the creative generativity of living language) and etymology. Sapir (1921) cautions against being "misled by structural features which are mere survivals of an older stage which have no productive life and do not enter into the unconscious patterning" [p.140], as does Marchand (1969) who states, "Productivity of a derivative type therefore cannot be overlooked in a correct description of a linguistic system, and the linguist who neglects this particular factor [productivity] will be counting 'dead souls' as live people." [p. 5] The results of this experiment on productivity indicate that the C&H rules relating to vowel alternation do indeed concern "dead souls" and should not be attributed to the competence of the native speaker.

Consequences of Invalid VSR. The finding that the VSR is non-productive and thus cannot be a general rule of English renders invalid most of C&H's underlying phonological representations for lexical items. This implication follows because the VSR and other associated rules form the only link between the hypothesized UPRs and the phonetic representation. Granting the validity of the phonetic representation, the postulated nature of the UPR is contingent upon the validity of the rules which link it to a phonetic representation. Thus, if a linking rule such as the VSR is determined to be invalid, then the hypothesized UPRs depending on that rule cannot be valid. The surrendering of the VSR demands an extensive revision of C&H's UPRs, since lexical items with tense vowels in their phonetic representation, vowels such as īʸ, ēʸ, āʸ, ōʸ, āʷ, ǣʷ, ūʷ, and ōʷ, would be assigned incorrect underlying representations. Such a

revision would result in UPRs that are less abstract, i.e., closer to the phonetic level of representation, than they are at present.

The necessity for a major revision of C&H's UPRs also renders less credible the rather extravagant claim of C&H (1968) that, "It is a widely confirmed empirical fact that underlying representations are fairly resistant to historical change, which tends, by and large, to involve late phonetic rules." [p. 49] Thus it is that C. Chomsky (1970) claims that a UPR based orthography would be adequate for "both British and American English, and the vast range of English dialects that exist within each country and around the world." [p. 295] Despite the C&H contention that it is a fact (a "widely confirmed empirical" one at that) that UPRs are resistant to historical change, there is reason to believe that this view is erroneous. The invalidation of the VSR as a general rule, with the consequence that underlying forms must be represented at a level closer to the phonetic level, leads one now to expect that the UPRs of lexical items may vary considerably from dialect area to dialect area.[4]

With variation in underlying forms, there can of course, be no simple solution to the problem of orthographic standardization. The selection of one dialect as a standard for the basis of an orthography cannot but result in some English speakers having more difficulty with it than others. Standardization of orthography is a real problem, and one from which there is no easy escape.

DUBIOUS ASSUMPTION 2: THE C&H UPR IS THE ONLY SOUND REPRESENTATION LISTED IN LEXICON. Even if the C&H VSR were a valid and general rule of English, the asuumption that their UPR is the only sound representation that may appear in the lexicon is one that is highly questionable. They hold, for example, that words such as mountain, right, and sign, have only their UPRs /mūntən/, /rixt/, and sīgn/, respectively, stored in the lexicon, even though such forms vary considerably from their phonetic representations. The phonetic representations [mā^{w}ntən], [rā^{y}t], and [sā^{y}n], do not appear in the C&H lexicon.

In assessing the validity of this C&H assumption, it is relevant to ask if there is a period of life for English speakers when a representation close to the phonetic aspect of a lexical item must be said to be directly linked with its meaning. Such a question must be answered in the affirmative, for when as young children we learned the meanings of words, what we undoubtedly did was associate what we heard with a meaning. That is to say, we linked a relatively unabstract sound representation directly with a meaning. Thus, for example, when we learned the word mountain, what we did was to associate a meaning with something like the representation [mā^{w}ntən]. Similarly, for right and sign we learned to associate meanings with sound representations like [rā^{y}t] and [sā^{y}n].

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That the child first establishes for each word a direct connection between meaning and a near phonetic representation is a proposition that Chomsky would likely support, since it is his opinion that full knowledge of the sound system is acquired by the child fairly late. He states that,

> "The conventional orthography corresponds closely to a level of representation that seems to be optimal for the sound system of a fairly rich version of ... spoken English. Much of the evidence that determines, for the phonologist, the exact form of this underlying system is based on considerations of learned words and complex derivational patterns. It is by no means obvious that a child of six has mastered this phonological system in full. He may not yet have been presented with the evidence that determined the general structure of this system .... It would not be surprising to discover that the child's intuitive organization of the sound system continues to develop and deepen as his vocabulary is enriched and as his use of language extends to wider intellectual domains and more complex functions. Hence the sound system that corresponds to the orthography may itself be a late intellectual product." [Quoted in C. Chomsky (1970), p. 301-2].

Thus, it appears that Chomsky would agree that at least until the child develops the underlying system of English phonology, the child must store something akin to a phonetic representation in his lexicon.

Abstract UPRs in Lexicon are Uneconomical. Now even if we grant that through the course of time, we develop the phonological rules and the underlying phonological representation which C&H postulate, is there any reason to suppose that in the process we would lose the original direct connection which had to have been established between the meaning and a near phonetic representation of a word? From a standpoint of efficiency, it seems more reasonable to assume that we continue to associate the meaning of a word directly with its near phonetic representation. How uneconomical it would be if we always had to involve many phonological rules in the production and understanding of speech, especially when we consider the derivational complexity which C&H claim is involved for most words. (Even for such an apparently simple word like spa, no less than five phonological rules are required by C&H in its derivation!) Given such phonological complexity, it does not seem possible to account for the fantastic speech with which speakers can interpret and produce speech.

In contrast, the postulation of a continuing near phonetic meaning association can significantly contribute to an accounting of rapid speech production and understanding, for there would be a great reduction in the amount of psychological work involved in relating meaning and sound. Considering that C&H in effect admit that speakers must learn a near phonetic and meaning association for many thousands of words during

their pre-school and early school years, and will have years of practice with these words, there is little basis for the C&H assumption that speakers lose this valuable learning simply because they learn more language and phonology as they grow older.

An Unenviable Dilemma. Furthermore, the C&H assumption that children come to form only an indirect connection between a phonetic representation and meaning for lexical items as they acquire phonological rules, obliges C&H to accept the psycholinguistic implication that, ceterus paribus, the rate at which children are able to produce and understand speech will decrease as they acquire more language! This implication follows from their theory because children must somehow use the phonological rules they acquire in order to associate the phonetic representation of a lexical item with a meaning, for, as C. Chomsky has stated above, "In producing and interpreting speech, a speaker of the language constantly operates in accordance with [phonological] rules ..." Since in conversation, "immediate direct identification" of lexical items is impossible (speakers do not speak in UPR equivalents), speakers are therefore obliged, to use C. Chomsky's words again, to "abstract away from the phonetic details" by the use of the complex phonological rules that are learned in late childhood.

Actually, C&H are in a dilemma. They must hold that the acquisition of phonological rules will decrease a speaker's rate of speech production and speech understanding, or they cannot hold that a UPR based orthography will permit a more rapid recovery of meaning than one that is phonetically based. After all, C&H claim that a phonetically based orthography will slow down a reader because the reader must "abstract away from phonetic details." If, therefore, a reader of a phonetically based orthography is slowed down because he must use phonological rules, then the same must happen to a speaker in conversation for the speaker must also use such rules. Thus, in order to give substance to their view regarding the optimality of a UPR based orthorgraphy, C&H must claim that the rate at which children produce and understand speech will decrease as they acquire more language. While it is possible that this claim could receive empirical confirmation, I would not like to be the theorist whose views are dependent on such an outcome.

A much more viable thesis and one which, does not lead to such a dilemma is the one which I propose above, i.e., that a relatively unabstract near phonetic representation is the sound representation that is stored in the lexicon. Such a position should not be interpreted as implying that abstract phonological rules are not acquired. On the contrary, such rules are acquired and will be required in speech for the production and understanding of novel words. These rules will not be required, however, in the case of familiar words. This issue will be further considered in the following discussion which concerns another of C&H's assumptions.

DUBIOUS ASSUMPTION 3: DERIVED FORMS CANNOT APPEAR AS WHOLE WORDS IN THE LEXICON. According to C&H, words such as extremity, tabular, ramify, destruction, retention, and national, are not stored as single words in the lexicon. Morphemes such as {extreme}, {-ity}, {destroy}, {-tion}, etc., appear in the C&H lexicon, but the words extremity and destruction do not. C&H hold that such words must be generated from their morpheme constitutents according to rule. Thus, every time a derived word is used, it must be created entirely anew from its component morpheme constituents.

However, because rules are necessary to account for such phenomena as the creation and understanding of novel derived words, is not sufficient reason to believe that such rules must continue to operate for words that were once novelly derived but which have become familiar, or for "derived" words the meanings of which were learned as a whole to the entire sound form. In my view, all of the meaning of a so-called derived word comes to be stored in the lexicon together with a sound representation of the whole word. That is, we learn to associate the meaning of the entire derived word directly with a sound representation.

The mediation of morphophonemic word-formation rules for making a sound-meaning pairing thus is not always required by the speaker. That mature speakers do know rules for affixing derivational morphemes is not denied. On the contrary, it is quite clear that speakers do have the capacity to create and understand novel forms from morphemes by the use of rules. However, it is fallacious to assume that just because a speaker knows such rules, he must always use these rules. A distinction between familiar and novel derived words should be made. While rules, for example, would be needed in order to coin novel words, such rules would not be needed for the production of familiar words. Familiar derived words would be stored as wholes in the lexicon.

There are a number of considerations which indicate that modification of C&H's hypothesis concerning the nature of a speaker's competence with regard to the lexicon is in order. For instance, a child may learn a great many derived words before he acquires what C&H consider full knowledge of the sound system (VSR, etc.). Very often, too, a derived form may be learned before the learning of a base form or any other constitutent morpheme, e.g., elevator probably would be learned before elevate. In such cases, there could be no alternative, the whole word must be stored in the lexicon. Another consideration is performance economy. If a speaker's use of rules is significantly time-consuming, and since the rapid rate of speech production and understanding is a phenomenon to be accounted for, then the storing of whole words in the speaker's lexicon can help to explain that phenomenon.

An even more important consideration perhaps is the question of whether the speaker of English who has learned the meaning of a derived word as a whole, e.g., equator, and who also learned in separate contexts the meaning of what might be called its constituent morphemes, {equate} and {-or}, knows (in a competence sense) that the word equator is composed of those morphemes. C&H assume that the native speaker does have such knowledge. They assume (Chomsky & Halle:159, 197), for example, that speakers know that the word tabular has the morpheme {tabl}, and that the noun attribute has the morpheme {attrib}. C. Chomsky (1970:298) asserts that native speakers know that the words majority and resign have the morphemes {major} and {sign}, respectively. But is it the case that a speaker has such knowledge? Concerning this issue, Ladafoged (1970:25) wonders if C&H would claim that speakers who know the words mnemonic and amnesia, also know that each is composed of a constituent morpheme, {mne}. (Notice, too, that the m is pronounced in amnesia but not in mnemonic.) If our intuition is to be our guide, most of us would probably deny having knowledge of that {mne} morpheme.

Concerning intuition, I often find myself quite surprised to learn of the morpheme composition of even the most ordinary of derived words. Only recently did I realize that the morpheme {equate} forms the basis of the words equator and equatorial. I suspect that this phenomenon of morpheme surprise for derived forms is very widespread among speakers. While C&H can say that I unconsciously had this knowledge all along, it should be noted that C&H offer no evidence in support of their position on this critical issue.

I think that C&H would have a much stronger case if they had argued that words with inflectional, and not derivational, morphemes are not stored as wholes in the lexicon. It could be said that words composed with inflectional affixes such as the plural, possessive, and past tense, are created anew each time, i.e., that dogs, boy's, and jumped are not stored as whole words in the lexicon, that the morphemes {dog}, {PLURAL}, {boy}, {POSSESSIVE}, {jump}, and {PAST} are stored in the lexicon, and, that the words in question are created by morphophonemic rule whenever they are needed.

In support of this proposal, one could argue that the meanings of words with inflectional affixes have wholly predictable meanings, given that one knows the meaning of the inflectional morpheme and the stem morpheme to which it is affixed. Consequently, a speaker can be sure that the meaning of these constituent morphemes entirely determines the meaning of the whole word. The meaning of such words is completely exhaustive. On the other hand, one can never be certain about the meanings of words involving derivational morphemes. The meaning of equator or elevator is certainly not provided a speaker if he

only knows the morphemes {equate}, {elevate}, and {-or}. When coming across novel words composed only with derivational morphemes, there is no way for a speaker to know beforehand whether those morphemes do or do not give the meaning of the whole, or even whether they are at all relevant. Because of these and so many uncertainties and problems involved in a derivational morpheme analysis (see Maher 1969, 1971 for a brilliant exposition) it is extremely doubtful that a speaker actually creates the derived form, but rather stores those words as wholes in the lexicon.

THE SURFACE PHONEMIC REPRESENTATION (SPR) LEVEL

Since the C&H Vowel Shift Rule is evidently not valid, and since some very basic C&H assumptions concerning the lexicon are extremely dubious, it is clear that a revision of the C&H UPR level is necessary. I propose that the UPR level be replaced with one which I term the surface phonemic representation level (hereafter, SPR). The SPR level is one which I maintain is psychologically real and one which can be rather clearly defined with respect to the C&H framework.

The essential characteristic of the SPR level is that it specifies a level of the sound system which ordinary native speakers can be said to be aware. Awareness on the part of speakers is not a criterion used by C&H in defining the UPR or phonetic representation levels. Thus, while C&H posit that the UPR for the word right is /rixt/, they do not expect speakers to be consciously aware of any of the segments of that form. Ordinary speakers, though, may be expected to be experientially aware of some, but not all aspects of phonetic representations. In contrast to the character of both the C&H UPR and the phonetic representation, I hold that a speaker may be expected to be entirely aware of the composition of the SPR, for such representation is to be based wholly on a consideration of what it is that the ordinary speaker consciously perceives concerning the sound structure of words.

Actually, because C&H do not use awareness as a principal criterion for determining a level of sound representation, they have difficulty in accounting for a most common language phenomenon, a speaker's report of what it is he hears when a word is spoken to him. Suppose, for example, that the word pipe is uttered and a speaker is asked to report on what sounds compose that word. Suppose, too, that he reported that the initial and final consonants were the same, both were "pee," and that the vowel was "[ā^{y}]". Are we to conclude that the speaker has mixed two different sound levels in his report? C&H would have to claim so, for according to them, the consonant report must have originated from the UPR level since aspiration is not distinctive there (it is indicated at the phonetic level), while the vowel report must have originated from the phonetic level where the vowel approximates ā^{y} rather that ī which is the vowel at the UPR level.

The SPR level which I am proposing has a great deal in common with the phonemic level proposed by the structuralists and with that level recently proposed by Schane (1971). The SPR consists of segments which are composed only of what C&H call 'phonological' features. Uniquely 'phonetic' features such as aspiration would not be included in an SPR specification since such features are not consciously distinctive to the native speaker. Similarly excluded from the SPR are integers corresponding to quantitative physical attributes, such as amount of aspiration and amount of tenseness, since these, too, are characteristics of which native speakers are normally not aware.

The SPR level differs, however, in a few important respects from the systematic phonemic level of most generativists. In particular, I hold that a speaker stores the SPRs of both morphemes and whole derived words in the lexicon. Thus, both the words extreme (SPR = /ekstrīm/) and extremity (SPR = /ekstremitī/), and the morpheme suffix {-ity} (SPR = /itī/) each appear in the lexicon with a meaning. Principally as a result of this revision of the lexicon, theorists no longer need posit a very abstract level of representation. A more abstract level is not required either to replace the surface phonemic level (the C&H proposal), or to complement the surface phonemic level (the Schane proposal).

In line with most generative theorists, I do not think that words having inflectional affixes usually appear as wholes in the lexicon. An inflected word may be generated by affixing an inflectional morpheme to a stem according to rule. Thus while we would expect to find listed in the lexicon the SPRs of such words as cliff, erase and Richard, we might not expect to find cliffs, erased and Richard's listed there, too. I say that we might not "expect" to find the latter items because I do not want to exclude the distinct possibility that highly frequent inflected words appear in their entirety in the lexicon. Thus, words like cats, dogs, Mary's, jumped, etc., may very well be listed as wholes in the lexicon of many speakers.[5] Typically, however, inflected words seem to be generated according to rule.

The SPR level which I propose corresponds rather closely to the descriptive system used by Kenyon & Knott (1944). It also corresponds closely to what C&H for the most part use throughout The Sound Pattern of English as the 'phonetic' representation. When presenting derivations, C&H usually do not indicate all of the raw phonetic details which they regard as necessary for a full phonetic representation (aspiration, integers, etc.). I submit that the underlying reason why C&H find it useful to use the abbreviated transcription and why it might be expected that their readers would find it easy to comprehend is that their reduced phonetic representation approximates a truly psychological level, that of the SPR.

Thus, I conclude that only an SPR description, based on a slow and careful pronunciation of words in isolation (words like writer and rider will therefore be distinguished), can provide the proper phonological foundation for an optimal orthography.

ADVANTAGES OF AN SPR BASED ORTHOGRAPHY

The SPR based orthography would permit a reader to recover the meaning of words at least as rapidly as has been claimed for C&H's hypothesized UPR based orthography. Since words written in a SPR based orthography would provide input at the SPR level, and, since the SPR of a word (or its constituent morphemes) is directly connected to its meaning, i.e., the SPR of a word is listed with its meaning in the lexicon, the mediation of rules would therefore be unnecessary. A SPR based orthography thus would allow for a direct identification of meaning and would not require the reader to "abstract away from phonetic details".

While as far as recovery speed for meaning is concerned, the SPR based orthography has the same advantage as C&H's UPR based orthography, the SPR based orthography has other important advantages which are not shared by the UPR based orthography. Three such advantages of a SPR based orthography are: 1) it is easy to teach and to learn 2) it may be learned at an early age, and 3) it permits a rapid detection of rhyme. Each will now be discussed in detail.

Advantage 1: SPR Based Orthography Easy to Teach and Learn. If an orthography is to be considered as a candidate for optimality, it should be relatively easy to teach and to learn. Essentially, normal persons who have learned their language, may learn an orthography by either of two methods of presentation. In the first, let us call it the orthography-object method, an orthographic form is presented in association with an object or event, e.g., the instructor presents <dog> written on paper and points to an actual dog. In the second, let us call it the orthography-utterance method, an orthographic form is presented in association with a speech utterance, e.g., the instructor presents <dad> wirtten on paper and says [dæd].

The first of these methods, the orthography-object method, is one that is often time-consuming and impractical. We don't always have objects and events, or pictures of objects or events at our disposal. Nor is it possible to present a direct representation for a variety of words in our vocabulary, e.g., prepositions and articles: to, with, the, a; feelings: pain, heat, wet; abstracts: intelligence, theory, quality. On the other hand, the second method, that of orthography-utterance, does not have such drawbacks. It requires only that an utterance be presented along with the orthographic form. As long as the learner can understand speech, he will know what word it is that the orthographic form is attempting to represent. It is not necessary for the learner to utter the word himself.

Suppose that one wanted to teach an orthography based on C&H's UPRs. Because of the limitations of the orthography-object presentation method, one would wish to use the orthography-utterance method. However, because the orthography-utterance method requires that words must be uttered by the instructor, the question arises as to whether an instructor teaching the UPR based orthography, should attempt to pronounce a phonetic equivalent of the UPR of the lexical item.[6] If one did attempt to pronounce the UPRs, certain major difficulties would immediately be encountered.

Firstly, a great many of C&H's UPRs would be difficult to pronounce since some words have segments which never occur in spoken English. We do not, for example, have the sound ɔ̄ə̄ in English (ɔ̄ə̄ is a rounded ǣ). Yet, ɔ̄ə̄ is the vowel found in the UPRs of such common words as boy, toy, and joy. Neither do we have the x which appears in /rixt/, the UPR of right. Even if an instructor were able to pronounce these UPRs, it would not likely be apparent to the learner what words such weird utterances were meant to represent. Under such conditions the orthography could not begin to be learned.

A second great difficulty relating to any attempt to teach a UPR based orthography by the pronunciation of UPRs is that many such forms would be misleading if uttered. For example, since the word mouse is given the underlying form /mūs/, if pronounced it would sound like the word moose. Other common lexical items which would mislead a learner are words like time, team, tame, whose C&H underlying forms would be pronounced like the words team, tame, and tam, respectively. The incidence of misleading items would thus be very high.

A final difficulty with attempting to pronounce UPRs, and one that is similar to the first, is that even if the pronounced UPRs sounded like English many words would come out as nonsense syllables. How would one know that the pronunciation of UPR /re=duke/ relates to reduce, or that the UPR /mūntən/ when pronounced relates to mountain? Clearly, because of this and the other difficulties, an approach which would involve the pronunciation of UPRs is not a viable one. If one wishes to teach the C&H UPR based orthography, it thus appears necessary to rely upon the normal pronunciation of words. Such an approach is the one which C. Chomsky uses in dealing with the problem.

However, if presented with the normal pronunciation of words, the learner of a UPR based orthography will still run into great difficulty. Given a pronunciation, what the learner must do is to recover the UPR of that word. A learner cannot simply match what he hears with the segments of the presented orthographic string in order to determine the proper value of each orthographic segment. In C. Chomsky's words, what the learner must do is to "abstract away from the phonetic details"

of the pronounced word in order to arrive at its UPR. For, only then will the learner have the opportunity to make the proper comparison (the UPR phonological string with the UPR orthographic string) and be able to determine precisely what it is that each orthographic symbol is designed to represent.

For example, suppose that in attempting to teach an orthography based on the UPRs proposed by C&H, the word right is uttered and the UPR written form is shown to a learner, in accord with the orthography-utterance method. Since according to C&H, the UPR for right is /rixt/, the learner will not learn what he is supposed to if he compares the conscious interpretation of what he perceives (perhaps /rā^{y}t/) with the symbols of the orthographic string, e.g., <rixt>, that is presented to him. He is not aware of a velar fricative /x/. What he must do is to recover the UPR /rixt/ from the speech input (presumably through the use of phonological rules), and then match /rixt/ with <rixt> so that the proper phonological value of each orthographic symbol can be determined.

However, because underlying phonological forms are posited by C&H to exist at an unconscious and very abstract level, it is possible that a learner may never even consider that it is the UPR that is to be related to the orthography. If such is the case, the UPR based orthographic system would never be learned. While it might be hoped that a learner's attention will focus on the UPRs of words through the presentation of exercises such as those which C. Chomsky recommends, the efficacy of such remedies is highly questionable. The following interchange with a child described as "... a seventh-grade girl, a child of average intelligence but a poor speller ..." from C. Chomsky (1970:304) illustrates this point rather vividly.

> "The next try showed how little understanding she had of the idea that words are actually connected to each other in meaning and form, even words that she was perfectly familiar with.
>
> --How do you spell "sign"?
>
> S-i-g-h-n
>
> --What do you call it when you sign your name?
>
> Your signature
>
> --How do you spell "signature"?
>
> S-i-g-n ...
>
> --OK. So how do you spell "sign"?
>
> S-i-g-h-n
>
> --But you told me that "signature" begins with S-I-G-N ...!
>
> So what's one got to do with the other?"

If, after such an exchange, a seventh-grade child of average intelligence still does not realize that such words as sign and signature are related and share UPRs, even though they are words with which she is perfectly familiar, then clearly, the crucial hypothesis that the orthography is related to the UPRs of lexical items is one that is very difficult to elicit. No such difficulty, however, attends an SPR based orthography.

That it is elements of the SPR level which are to be associated with elements of the orthography, is a relatively easy idea for a learner to acquire. One can prime, so to speak, the SPR level of a speaker rather directly. For example, one might utter a sound and then ask a learner to reproduce or identify the sound which he has heard. Suppose the teacher utters the diphthong [$\bar{a}^{y}$]. The child could then be asked to reproduce the sound that he heard, or he could be asked to select the vowel sound he heard from a number of choices, e.g., [$\bar{a}y$] or [i]. We would expect any normal speaker to be able to perform such tasks without difficulty. Where it would be inappropriate or misleading to deal with a sound unit in isolation, as with [g] or [t], selected contexts or minimal pairs may be used. The learner of an SPR based orthography could be told explicitly and in relatively simple language what it is that he must learn. He could be told that different orthographic elements represent sounds that he hears.

There would be no problem in communicating the basic principle of the SPR system. Examples could be given and explained without a great deal of difficulty. Because of the high saliency of consciously perceived sounds, a learner would probably experience little trouble in determining the basic orthographic principle even if he were taught to read SPR based materials wholly through inductive means.

To the learner of an abstract UPR based orthography, an instructor could only say something to the effect that each orthographic element represents not an actual sound, but something that underlies the sound. Such a statement would, of course, be of little help to the learner, since he is not consciously aware of any abstraction which underlies what he hears. Only special linguistic training could possibly make a learner (and an instructor) intellectually cognizant of what it is that a UPR based orthography attempts to represent. Of course, given the nature of UPRs, it is not likely that any amount of training can ever bring UPRs to awareness.

The non-conscious character of UPRs would also be a great handicap to spellers of a UPR based orthography. Conscious effort can do little directly for those spellers. On the other hand, conscious effort can do a great deal for spellers of an SPR based orthography. All the SPR speller need do is to bring to consciousness the sound representation of the word he wants to spell, and then select the appropriate letters from his inventory of orthographic symbols.

Advantage 2: SPR Based Orthography May Be Learned Early. Because the learner must first know the phonological rules which relate phonetic representations to UPRs before he can learn a UPR based orthography, children would ordinarily be halfway through grade school by the time they would be ready to begin to master such an orthography. For, according to the Chomskys, "... full knowledge of the sound system that would correspond to a UPR based orthography is not yet possessed by the child of six or seven, and may indeed be acquired fairly late." [C. Chomsky, 1970:301] C. Chomsky's solution to this problem of having to wait until children acquire the necessary phonological rules of their language, is to accelerate their rate of language acquisition, i.e., teach them more language. Specifically, she advocates the teaching of a rather sophisticated vocabulary in the early grades. She holds that

> "Extending the child's vocabulary to include Latinate forms and polysyllabic derived forms is one of the best ways to provide him with the means of constructing the phonological system of his language more fully as he matures. He ought to become familiar with word groups such as industry-industrial, major-majority, history-historical-historian, wide-width, sign-signature, etc., and have their relationships made explicit for him." [C. Chomsky, 1970:302]

However, even if such learning would facilitate and accelerate the internalization of the phonology of the language, the teaching that would be necessary to instill the necessary language knowledge would itself take a great deal of school time. A child would still be relatively old before he would be ready for an orthography that was UPR based. Also, because the more sophisticated aspects of language would have to be acquired by children before they could learn the systematic foundations of a UPR based orthography, children of less than average intelligence or with less language development would be placed at a serious disadvantage in the learning of reading with respect to his peers.

It should be pointed out that C. Chomsky does not advocate that reading be delayed entirely until the child acquires complete knowledge of the sound system. What she does hold is that reading be taught, but that "At some point emphasis ought to be shifted away from the phonetic aspects of spelling to a consideration of the underlying lexical properties of the orthographic system." [C. Chomsky, 1970:297] However, consider the burden that is being placed on the child. The child will be required to unlearn much of what he has already learned. He must even unlearn a hypothesis that would have been confirmed very often in his experience, the hypothesis that the orthography relates to a level of representation that is close to the phonetic. Since so many words have vowels and consoaants that are much the same in both their UPR and phonetic representation, a learner could receive frequent confirmation of this especially salient

hypothesis. Because the child who is to learn a UPR based orthography must unlearn many of the sound-symbol correspondences he has learned and must learn a new principle for orthography after having learned another, such a task cannot be expected to be an easy one for him.

Advantage 3: SPR Based Orthography Permits Rapid Detection of Rhyme. Granting that in the lexicon it is the SPR of a word that is stored with its meaning, an SPR based orthography would permit a reader to detect rhyme rather quickly. Such a feature is an important one, especially in the reading (silently or aloud) and the writing of poetry.

Consider:

(1) He though it right so he flew a kite.

or (2) It the sign of someone divine.

How would C&H account for the rhyme between right and kite or sign and divine with their phonological system and their UPR based orthography? Since the UPRs for the first pair are /rixt/ and /kīt/, and for the second pair are /sign/ and /divīn/, it is clear that rhyme cannot be perceived at the UPR level. Obviously rhyme must occur at some other level which is less abstract. An orthography based on C&H's UPRs, therefore, would require a reader to do some phonological processing in order to obtain a sound representation on the basis of which rhyme may be detected. Such processing is necessary on the basis of the C&H system since only UPRs are listed with meanings in the lexicon.

On the other hand, no such time-consuming processing would be required by an SPR based orthography since since such an orthography would provide input directly to a level at which rhyme may be perceived. Since the SPRs for the lexical items cited above would be /raʏt/ and /kāʏt/, and /sāʏn/ and /divāʏn/, the detection of rhyme becomes a much less complicated matter.

OPTIMAL ORTHOGRAPHY FOR ENGLISH

Considering (1) that Chomsky and Halle's assumptions regarding the validity of the Vowel Shift Rule and the exclusion of derived words from the lexicon are extremely dubious, considering (2) the probable validity of the Surface Phonemic Representation level, and considering (3) the advantages of an SPR based orthography, i.e. it is easy to teach and learn, can be learned at an early age, and will permit a rapid detection of rhyme, I must conclude that an orthography based on C&H's UPRs would not be one that is optimal for English. A more likely candidate for the optimality award would be an orthography that is based on the proposed SPR phonological level.

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FOOTNOTES

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2. Request for reprints should be sen' to Danny D. Steinberg, Department of English as a Second Language, University of Hawaii, Honolulu, Hawaii 96822.

3. To avoid a possible misunderstanding, it is perhaps best to state now that I do not object to the postulation of underlying phonological representations. In fact, later in the paper I propose an underlying phonolgical representation level which I call the surface phonemic (SPR). The SPR is an alternative to C&H's particular underlying phonological representation level which I will often refer to as UPR.

4. One prominent generative phonologist who does not appear to share the C&H view is Kiparsky (1968:187). He presents an example of two closely related Swiss-German dialects which have different UPRs. One dialect is postulated to have a 3 height vowel system, the other, a 4 height vowel system.

5. Since speakers are unaware of any difference between the final consonant on cat<u>s</u> and the one on dog<u>s</u>, the SPR would give both the same representation, as do generative phonologists, albeit for a different reason. This analysis contrasts with that of the structural phonemicist who would assign two different phonemic representations to the consonants in question, an /s/ for cat<u>s</u> and a /z/ for dog<u>s</u>. Whether the [ɨz] on fox<u>es</u> should or should not include a vowel in its SPR, as /s/ or as /ɨs/ is not clear. (/z/ or /ɨz/ is another possibility.) Perhaps the vowel should be included because speakers are quite aware that <u>fox</u> is composed of one syllable but that <u>foxes</u> is composed of two. No change in the syllable count occurs with the pluralization of <u>cat</u> or <u>dog</u>.

6. Although according to C&H the UPR is related only indirectly to pronunciation (via phonological rules), such a theoretical formulation does not preclude attempts at a direct pronunciation of the phonetic equivalents of UPRs for <u>practical</u> purposes such as language learning or reading.